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MAT 111 104 Mechanical Engineering

① $\int x^{1/2} \ln x \, dx$

Let $U = \ln x$, $dv = x^{1/2} dx$

$\frac{du}{dx} = \frac{1}{x}$, $\int dv = v = \frac{x^{3/2}}{3/2} = \frac{2x^{3/2}}{3}$

$= uv - \int v \, du$

$= \frac{2x^{3/2}}{3} \ln x - \frac{2}{3} \int x^{3/2} \cdot \frac{1}{x} \, dx$

$= \frac{2x^{3/2}}{3} \ln x - \frac{2}{3} \int x^{1/2} \, dx$

$= \frac{2x^{3/2}}{3} \ln x - \frac{2}{3} \cdot \frac{x^{3/2}}{3/2} + C$

$= \frac{2x^{3/2}}{3} \ln x - \frac{2}{3} \times \frac{2}{3} x^{3/2} + C$

$= \frac{2x^{3/2}}{3} \left(\ln x - \frac{2}{3} \right) + C$ //

② $2 \int \cos 6t \cos t \, dt$

$= \frac{1}{2} (\cos(A+B) + \cos(A-B))$

$= 2 \left[\frac{1}{2} \cos(6t+t) + \cos(6t-t) \right]$

$= 2 \int \cos 7t + \cos 5t$

$= \frac{\sin 7t}{7} + \frac{\sin 5t}{5} + C$

(3) $\int \sin^3 x \cos^4 x \, dx$

let $u = \cos x$, $du = -\sin x \, dx$

$$\int \sin^3 x \cos^4 x \, dx = \int \sin^3 x (1 - \sin^2 x)^2 \, dx$$

$$\int u^3 (1-u^2)^2 \, du = \int u^3 (1 - 2u^2 + u^4) \, du$$

$$= \int (u^3 - 2u^5 + u^7) \, du$$

Integrating

$$\Rightarrow \frac{u^4}{4} - \frac{2u^6}{6} + \frac{u^8}{8} + C$$

$$u^4 \left(\frac{1}{4} - \frac{1u^2}{3} + \frac{u^4}{8}\right) + C$$

$$= \cos^4 x \left(\frac{1}{4} - \frac{\cos^2 x}{3} + \frac{\cos^4 x}{8}\right) + C \quad \text{Ans}$$